ALABAMA DEPARTMENT OF TRANSPORTATION

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Bob Riley
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July 31, 2007

MEMORANDUM 2007-15

To: County Engineers

Cc: Division County Transportation Engineers

From: _____
Ed Phillips, P.E. State County Transportation Engineer

Reference: Traffic Stripe Testing

As you are all aware, at the end of last year the ALDOT Standard Specification for Section 701 (Traffic Stripe) was revised when we moved from hydrocarbon-based thermoplastic to latex-based thermoplastic. A part of this revision was an increase in the type and frequency of testing. This testing was required for all projects through the March 2007 letting.

The purpose of this increased type and frequency of testing was to ensure that with the change in thermoplastic material we were getting the finished product specified. Enough data was obtained from the new testing requirements during this period to convince us that we were getting the finished product that was specified. Therefore, Special Provision 06-0276(4), effective April 1, 2007 (attached), was adopted. Special Provision 06-0276(4) in essence allows the Engineer to determine the number and locations of Traffic Stripe testing.

After consultation with the ADOT Materials & Tests and Construction Bureaus, who were responsible for writing Special Provision 06-0276(4), this office has confirmed that no Traffic Stripe testing is required if the product applied meets the Engineer's satisfaction. However, this office recommends that, at a minimum, the Engineer perform a visual day and night-time inspection of any Traffic Stripe placed as part of any project containing Special Provision 06-0276(4). This visual day and night-time inspection should enable the Engineer to determine if the width, thickness, retroreflectivity, and luminance of the Traffic Stripe are acceptable. If following the day and night-time inspection, the Engineer should have any question as to the acceptability of the Traffic

Stripe, the Engineer can then require the additional testing he/she feels necessary as specified in Special Provision 06-0276(4).

If you should have any questions or comments concerning this matter, please feel free to contact me at (334) 242-6203.

DEP/dep

Pc: Mr. Joe McInnes, Transportation Director
Mr. Mark D. Bartlett, FHWA Division Administrator
Mr. Don Vaughn, P.E., Chief Engineer/Deputy Director
Mr. Don Arkle, P.E., Assistant Chief Engineer, Policy & Planning
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ALABAMA DEPARTMENT OF TRANSPORTATION

DATE: March 19, 2007 Special Provision No. 06-0276(4)

EFFECTIVE DATE: April 1, 2007

SUBJECT: Traffic Stripe, Markings and Legends.

Alabama Standard Specifications, 2006 Edition, shall be amended by replacing SECTIONS 701, 703 and 856 with the following:

SECTION 701
TRAFFIC STRIPE

701.01 Description.

This Section shall cover the work of placing a permanent or temporary traffic stripe at the locations shown on the plans or where directed by the Engineer. This Section shall also cover the removal of existing or temporary traffic stripe.

701.02 Materials.

Materials shall be furnished in accordance with the requirements given in Sections 856 and 857. The required dimensions, color, class, retroreflectivity and type of stripe will be shown on the plans.

The required type of material will be designated by "Class" in accordance with the following.

CLASS OF TRAFFIC STRIPE	
CLASS	MATERIAL
1	Paint
1H	High Build Paint
2	Standard Thermoplastic Material
2T	Thin Film Spray Applied Thermoplastic Material
3	Tape
W	Warranted Traffic Marking Material

The required reflectivity will be designated by "Type" in accordance with the following.

TYPE OF TRAFFIC STRIPE	
TYPE	REFLECTIVITY
A	Reflective
B	Non-reflective

Class 1H, Class 2, and Class 2T materials shall be in compliance with the formulations given in the tables in Section 856 for each class.

Class 1, Class 3, Class W and Drop On Glass Beads shall be one of the materials shown on List V-3, Temporary Traffic Marking Materials, and List V-4, Permanent Traffic Marking Materials. These lists are in the Department's Manual, "Materials, Sources, and Devices with Special Acceptance Requirements". Information concerning these lists is given in Subarticle 106.01(f) and ALDOT-355.

701.03 Construction Requirements.

(a) ACCEPTANCE PROGRAM FOR TRAFFIC MARKING MATERIALS.

The guidelines for the evaluation and acceptance of traffic marking materials are given in the procedure ALDOT-420 "Acceptance Program for Traffic Marking Materials". These guidelines shall be followed in the furnishing and placement of stripe.

(b) TEMPORARY TRAFFIC STRIPE.

1. REQUIREMENT FOR TEMPORARY STRIPE.

A roadway shall not be opened to traffic without a traffic stripe unless approved otherwise by the Engineer. Lane lines shall be maintained at all times when traffic is required to pass through the areas of construction. Existing lane lines covered by paving operations shall be replaced with temporary stripe.

Temporary edge lines will not be required unless shown to be required on the plans or required by the Engineer.

2. ALLOWABLE TEMPORARY STRIPE MATERIAL.

Temporary traffic stripe shall be reflective (Type A) and shall be:

- Permanent Traffic Marking Materials (Class 1, LIST V-4) or;
- Removable Traffic Paint (List V-3) or;
- Removable Tape (List V-3).

3. WEATHER CONDITIONS FOR THE APPLICATION OF TEMPORARY STRIPE.

Temporary striping may be placed without regard to the weather conditions if allowed by the Engineer.

4. CONFIGURATION OF TEMPORARY STRIPE.

A broken line of temporary stripe shall consist of 4 inch {100 mm} wide by 8 foot {2.4 m} long markings placed on 40 foot {12 m} centers. A solid line of temporary stripe shall be a continuous 4 inch {100 mm} wide stripe. Other width stripes may be required as shown on the plans.

5. TEMPORARY TRAFFIC MARKING TAPE.

Temporary traffic marking tape shall be applied as recommended by the tape manufacturer or as directed by the Engineer. Any failure of traffic marking tape shall be repaired immediately.

6. REMOVABLE TRAFFIC PAINT.

Removable traffic paint shall be placed at the rate recommended by the manufacturer.

7. REMOVAL OF TEMPORARY STRIPE.

A temporary solid line stripe of marking tape used on an underlying pavement layer, or any type temporary stripe of marking tape used on a wearing surface shall be removed.

A temporary solid or broken line stripe of paint used on a wearing surface shall be removed if it is not to be completely covered with a Class 1H or 2 permanent stripe.

Other types of temporary stripe may remain in place if the temporary stripe will be covered by the placement of paving layers or permanent stripe.

(c) CLASS 1 PAINT.

1. USAGE OF CLASS 1 PAINT.

Class 1 paint shall be used for temporary striping unless shown otherwise on the plans. Class 1 paint shall not be applied to concrete surfaces.

2. CLEANING SURFACES PRIOR TO THE APPLICATION OF CLASS 1 PAINT.

Areas to be striped shall be thoroughly cleaned of all dirt, oil and other debris in a way that will not damage the pavement surface. Striping shall not begin until the Engineer has inspected the pavement surface and has informed the Contractor that striping may begin.

3. WEATHER CONDITIONS FOR THE APPLICATION OF CLASS 1 PAINT.

Class 1 paint may be placed without regard to the weather conditions if allowed by the Engineer.

4. EQUIPMENT FOR THE APPLICATION OF CLASS 1 PAINT.

Equipment for the application of Class 1 paint shall be designed to place the paint and reflective beads when required. The equipment shall be capable of placing the materials at the required rates of placement and within the allowable placement tolerances.

5. REQUIRED RATE OF PLACEMENT OF CLASS 1 PAINT STRIPE.

Class 1 paint for temporary applications shall be placed at the rate of 10 gallons per mile for a 4 inch wide solid stripe {24 L/km for a 100 mm wide solid stripe} except for the following circumstances. The rate of placement for temporary applications shall be 18 gallons per mile for a 4 inch wide solid stripe {43 L/km for a 100 mm wide solid stripe} on rough pavement surfaces such as Open Graded Friction Course (OGFC), milled surfaces, or when used as a temporary stripe that will not be covered within 60 calendar days.

Class 1 paint for permanent applications shall be placed at the rate of 18 gallons per mile for a 4 inch wide solid stripe {43 L/km for a 100 mm wide solid stripe} except for the following circumstances. The rate of placement for permanent applications shall be 22 gallons per mile for a 4 inch wide solid stripe {52.0 L/km for a 100 mm wide solid stripe} on rough pavement surfaces such as Open Graded Friction Course (OGFC) and milled surfaces.

The rates of placement for 6 inch {150 mm} wide stripe shall be increased in a proportion to the increase in the width of the stripe from 4 inches {100 mm} to 6 inches {150 mm}.

Paint stripe that is placed at a rate that is not greater than 95 % of the required rate shall be replaced or covered with an additional application of paint stripe without compensation as directed by the Engineer.

(d) CLASS 1H, HIGH BUILD PAINT.

1. USAGE OF CLASS 1H PAINT.

Class 1H paint shall be used for maintenance and permanent striping and for other circumstances designated by the Engineer.

Class 1H paint may be applied to asphalt and concrete surfaces. Asphalt pavement shall be allowed to cure for a period of 14 calendar days before the application of the Class 1 H paint. Concrete pavement shall be allowed to cure for a period of 30 calendar days before the application of the Class 1 H paint.

2. PREPARATION OF SURFACES PRIOR TO THE APPLICATION OF CLASS 1H PAINT.

Areas to be striped shall be thoroughly cleaned of all dirt, oil and other debris in a way that will not damage the pavement surface. Striping shall not begin until the Engineer has inspected the pavement surface and has informed the Contractor that striping may begin.

Curing compound on concrete surfaces shall be removed by grinding, wire brushing, sand blasting or other effective means.

3. WEATHER CONDITIONS FOR THE APPLICATION OF CLASS 1H PAINT.

Permanent Class 1H paint shall not be placed during rain or mist or if the pavement surface is wet. Class 1H paint shall only be placed when the pavement temperature is 45 °F {7 °C} and rising.

4. EQUIPMENT FOR THE APPLICATION OF CLASS 1H PAINT.

Equipment for the application of Class 1H paint shall be designed to place the paint, and reflective beads when required, at the required rates of placement and within the allowable placement tolerances.

5. REQUIRED RATE OF PLACEMENT OF CLASS 1H PAINT STRIPE.

Class 1H paint shall be placed at the rate given in the following table. Rough pavement surfaces are such surfaces as Open Graded Friction Course (OGFC) and milled surfaces.

REQUIRED RATE OF PLACEMENT OF CLASS 1H PAINT gallons/mile {L/km}				
TYPE OF PAVEMENT SURFACE	6" {150 mm} WIDE STRIPE		4" {100 mm} WIDE STRIPE	
	Solid	Broken	Solid	Broken
Smooth Pavement Surface	41.1 {98.2}	10.3 {24.6}	27.4 {65.5}	6.9 {16.5}
Rough Pavement Surface	46.1 {110.1}	15.3 {36.6}	32.4 {77.4}	11.9 {28.4}

Class 1H paint stripe that is placed at a rate that is not greater than 95 % of the required rate shall be replaced or covered with an additional application of paint stripe without compensation as directed by the Engineer.

The required width of the stripe will be shown on the plans.

6. PLACEMENT OF DROP ON REFLECTIVE BEADS ON CLASS 1H PAINT.

Type 3 glass beads shall be placed on the Class 1H paint at a rate of 264 pounds per mile for a 6 inch solid wide stripe {112 kg/km for 150 mm wide solid stripe}. If beads are not placed at a rate that is greater than 95 % the required rate the stripe shall be replaced or covered with an additional application of paint stripe without compensation as directed by the Engineer.

7. RETROREFLECTIVITY OF CLASS 1H PAINT.

The retroreflectivity shall be a minimum of 350 mcd/lux/sq m for white stripe and 250 mcd/lux/sq m for yellow stripe. The Engineer will measure the retroreflectivity in accordance with the requirements given in ALDOT-422 "Method of Retroreflectivity Measurement of Traffic Marking Materials" with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. *

8. COLOR AND LUMINANCE FACTOR OF CLASS 1H PAINT.

The color and luminance factors shall meet the requirements given in Section 856. The Contractor shall remove and replace stripe, markings and legends that do not meet the color and luminance factor requirements. The removal and replacement shall be done without additional compensation.

The Engineer will measure the daytime luminance factor and chromaticity in accordance with the requirements given in ASTM E 1349 and ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. The instrument will be set to read x, y and Y coordinates with 45 degree/0 degree bi-directional geometry, observer angle of 2 degrees, and illuminant D65. *

(e) CLASS 2, STANDARD THERMOPLASTIC.

1. USAGE OF CLASS 2 THERMOPLASTIC.

Class 2 thermoplastic shall be used for permanent striping, and for other circumstances designated by the Engineer. Class 2 thermoplastic may be applied to asphalt and concrete surfaces. Asphalt pavement shall be allowed to cure for a period of 14 calendar days before the application of the thermoplastic. Concrete pavement shall be allowed to cure for a period of 30 calendar days before the application of the thermoplastic.

2. SURFACE PREPARATION PRIOR TO THE APPLICATION OF CLASS 2 THERMOPLASTIC.

Areas to be striped shall be thoroughly cleaned of all dirt, oil and other debris in a way that will not damage the pavement surface.

Curing compound on concrete surfaces shall be removed by grinding, wire brushing, sand blasting or other effective means.

A primer, sealer or surface preparation adhesive of the type recommended by the manufacturer of the Class 2 thermoplastic shall be applied to concrete surfaces (concrete pavement and bridge decks) before the application of the thermoplastic. Longitudinal stripes shall be offset at least 2 inches {50 mm} from longitudinal joints in concrete surfaces.

Striping shall not begin until the Engineer has inspected the pavement surface and has informed the Contractor that striping may begin.

3. WEATHER CONDITIONS FOR THE APPLICATION OF CLASS 2 THERMOPLASTIC.

Class 2 thermoplastic shall not be placed during rain or mist or if the pavement surface is wet. The pavement surface temperature shall be at least 50 °F {10 °C} and rising before application will be allowed to asphalt pavement surfaces. The pavement surface temperature shall be at least 60 °F {16 °C} and rising before application will be allowed to concrete pavement surfaces.

4. EQUIPMENT FOR THE APPLICATION OF CLASS 2 THERMOPLASTIC.

The equipment shall be capable of placing thermoplastic and beads at the required rates of placement and within the allowable placement tolerances.

The equipment shall have the capacity to maintain the thermoplastic at temperatures greater than 390 °F {200 °C}. The temperature of the thermoplastic shall be greater than 390 °F {200 °C} at the point of application.

The equipment shall be capable of applying glass beads to the surface of the stripe by a double drop application. The bead dispenser for the first bead drop shall be attached to the striping machine so that the beads are dispensed closely behind the thermoplastic material. The second bead dispenser shall be attached to the striping machine so that the beads are dispensed immediately after the first bead drop application. The bead dispensers shall be equipped with an automatic cut-off control that is synchronized with the cut-off of the thermoplastic material. The dispensers shall apply the glass beads to produce a uniform appearance on the entire surface of the stripe and 50 % embedment of the beads. The Engineer will make the determination of the acceptability of the bead embedment by visual inspection.

5. REQUIRED THICKNESS OF CLASS 2 THERMOPLASTIC MATERIAL.

Class 2 thermoplastic shall be placed to produce a minimum uniform thickness of 0.100 inches {2.5 mm} for all stripes. The thermoplastic shall be placed to not less than 95 % of this required thickness. The required width of the stripe will be shown on the plans.

The Engineer will measure the thickness and width of stripe in accordance with the requirements given in ALDOT-423 "Method of Measuring Traffic Stripe and Traffic Control Legends and Markings" with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. The Contractor shall remove and replace stripe that does not meet the thickness requirement. The removal and replacement shall be done without additional compensation. } *

6. PLACEMENT OF DROP ON REFLECTIVE BEADS ON CLASS 2 THERMOPLASTIC.

Type 1 and Type 4 glass beads shall each be placed on the Class 2 thermoplastic at a rate of 8 to 10 pounds per 100 square feet {3.6 to 4.5 kg per 9.3 m^2} of Type 4 beads and a rate of 6 to 8 pounds per 100 square feet {2.7 to 3.6 kg per 9.3 m^2} of Type 1 beads for a total rate of 422 pounds of glass beads per mile for a 6 inch solid wide stripe {179 kg/km for 150 mm wide solid stripe}. If beads are not placed at a rate that is greater than 95 % the required rate the stripe shall be replaced or covered with an additional application of paint stripe without compensation as directed by the Engineer.

Type 4 glass beads shall be placed through the dispenser before the Type 1 beads.

7. RETROREFLECTIVITY OF CLASS 2 THERMOPLASTIC.

The retroreflectivity shall be a minimum of 450 mcd/lux/sq m for white stripe and 350 mcd/lux/sq m for yellow stripe. The Contractor shall replace stripe that is 90 % or less of this retroreflectivity requirement. Stripe shall be removed and replaced without additional compensation.

The Engineer will measure the retroreflectivity in accordance with the requirements given in ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. } *

8. COLOR AND LUMINANCE FACTOR OF CLASS 2 THERMOPLASTIC.

The color and luminance factors shall meet the requirements given in Section 856. The Contractor shall remove and replace stripe, markings and legends that do not meet the color and

luminance factor requirements. The removal and replacement shall be done without additional compensation.

The Engineer will measure the daytime luminance factor and chromaticity in accordance with the requirements given in ASTM E 1349 and ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. The instrument will be set to read x, y and Y coordinates with 45 degree/0 degree bi-directional geometry, observer angle of 2 degrees, and illuminant D65. *

(f) CLASS 2T, THIN FILM SPRAY APPLIED THERMOPLASTIC.

1. USAGE OF CLASS 2T THERMOPLASTIC.

Class 2T thermoplastic shall be used for permanent striping, and for other circumstances designated by the Engineer. Class 2T thermoplastic may be applied to asphalt and concrete surfaces. Asphalt pavement shall be allowed to cure for a period of 14 calendar days before the application of the thermoplastic. Concrete pavement shall be allowed to cure for a period of 30 calendar days before the application of the thermoplastic.

2. SURFACE PREPARATION PRIOR TO THE APPLICATION OF CLASS 2T THERMOPLASTIC.

Areas to be striped shall be thoroughly cleaned of all dirt, oil and other debris in a way that will not damage the pavement surface.

Curing compound on concrete surfaces shall be removed by grinding, wire brushing, sand blasting or other effective means.

A primer, sealer or surface preparation adhesive of the type recommended by the manufacturer of the Class 2T thermoplastic shall be applied to concrete surfaces (concrete pavement and bridge decks) before the application of the thermoplastic. Longitudinal stripes shall be offset at least 2 inches {50 mm} from longitudinal joints in concrete surfaces.

Striping shall not begin until the Engineer has inspected the pavement surface and has informed the Contractor that striping may begin.

3. WEATHER CONDITIONS FOR THE APPLICATION OF CLASS 2T THERMOPLASTIC.

Class 2T thermoplastic shall not be placed during rain or mist or if the pavement surface is wet. The pavement surface temperature shall be at least 50 °F {10 °C} and rising before application will be allowed to asphalt pavement surfaces. The pavement surface temperature shall be at least 60 °F {16 °C} and rising before application will be allowed to concrete pavement surfaces.

4. EQUIPMENT FOR THE APPLICATION OF CLASS 2T THERMOPLASTIC.

Equipment for the application of Class 2T thermoplastic shall be designed to place the thermoplastic and beads at the required rates of placement and within the allowable placement tolerances.

The equipment shall have the capacity to maintain the thermoplastic at temperatures greater than 390 °F {200 °C}. The temperature of the thermoplastic shall be greater than 390 °F {200 °C} at the point of application.

5. REQUIRED THICKNESS OF CLASS 2T THERMOPLASTIC MATERIAL.

Class 2T thermoplastic shall be placed to produce a minimum uniform thickness of 0.040 inches {1.0 mm}. The thermoplastic shall be placed to not less than 95 % of this thickness. The required width of the stripe will be shown on the plans.

The Engineer will measure the thickness and width of stripe in accordance with the requirements given in ALDOT-423 "Method of Measuring Traffic Stripe and Traffic Control Legends and Markings" with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. The Contractor shall remove and replace stripe that does not meet the thickness requirement. The removal and replacement shall be done without additional compensation. *

6. PLACEMENT OF DROP ON REFLECTIVE BEADS ON CLASS 2T THERMOPLASTIC.

Type 1 glass beads shall be placed on the Class 2T thermoplastic at a rate 264 pounds per mile for a 6 inch solid wide stripe {112 kg/km for 150 mm wide solid stripe}. If beads are not

placed at a rate that is greater than 95 % the required rate the stripe shall be replaced or covered with an additional application of paint stripe without compensation as directed by the Engineer.

7. RETROREFLECTIVITY OF CLASS 2T THERMOPLASTIC.

The retroreflectivity shall be a minimum of 300 mcd/lux/sq m for white stripe and 250 mcd/lux/sq m for yellow stripe. The Contractor shall replace stripe that is 90 % or less of this retroreflectivity requirement. Stripe shall be removed and replaced without additional compensation.

The Engineer will measure the retroreflectivity in accordance with the requirements given in ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. *

8. COLOR AND LUMINANCE FACTOR OF CLASS 2T THERMOPLASTIC.

The color and luminance factors shall meet the requirements given in Section 856. The contractor shall remove and replace stripe, markings and legends that do not meet the color and luminance factor requirements. The removal and replacement shall be done without additional compensation.

The Engineer will measure the daytime luminance factor and chromaticity in accordance with the requirements given in ASTM E 1349 and ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements. Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe. The instrument will be set to read x, y and Y coordinates with 45 degree/0 degree bi-directional geometry, observer angle of 2 degrees, and illuminant D65. *

(g) CLASS 3, TAPE.

Class 3 Tape shall be used for permanent striping, and for other circumstances designated by the Engineer.

Class 3 tape shall be applied in accordance with the procedures recommended by the manufacturer. Tape stripe shall not be placed when the pavement temperature is below 60 °F {16 °C}. Tape may be placed at lower temperatures if shown in the manufacturer's recommendations for placement and allowed by the Engineer.

The retroreflectivity of the Class 3 tape shall be a minimum of 450 mcd/lux/sq m for white tape and 350 mcd/lux/sq m for yellow tape. The Contractor shall replace tape that does not meet this retroreflectivity requirement. Tape shall be replaced without additional compensation. The Engineer will measure the retroreflectivity in accordance with the requirements given in ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements.

The daytime luminance factor and chromaticity of the installed traffic stripe, markings and legends will be measured by the Engineer in accordance with the requirements given in ASTM E 1349 and ALDOT-422 with the exception that the Engineer will determine the number and locations of the measurements. The instrument will be set to read x, y and Y coordinates with 45 degree/0 degree bi-directional geometry, observer angle of 2 degrees, and illuminant D65. *

Measurements will be made between 7 and 30 calendar days after the completion of the placement of all stripe.

(h) WARRANTED TRAFFIC MARKING MATERIALS.

Class W traffic marking materials shall be used for permanent striping, and for other circumstances designated by the Engineer.

Class W traffic marking materials shall be applied in accordance with the procedures recommended by the manufacturer.

(i) REMOVING STRIPE AND MARKERS.

Existing traffic stripe (permanent or temporary), markers and adhesive shall be removed by a method that will not damage or disfigure the appearance of surfaces that will be visible at the completion of construction. Burning or painting over the old stripe will not be permitted.

Removal of traffic stripe, existing or temporary, will be paid for as a separate item of work.

(j) PLACEMENT LOCATION.

The Engineer will set the limits of no-passing zones. The Contractor shall provide all other controls required to place the stripe in accordance with the details shown on the plans or as directed by the Engineer. The Contractor shall establish guides or mark the surfaces prior to the placement of the stripe to allow the Engineer to verify that the stripe will be installed in the required location.

The Contractor may be required to adjust the operation of the striping equipment to cover the width and length of existing stripe.

(k) WIDTH AND LENGTH PLACEMENT TOLERANCES.

1. PERMANENT STRIPING.

A tolerance of 1/2 of an inch {13 mm} over or 1/8 of an inch {3 mm} under the required 4 inch {100 mm} or 6 inch {150 mm} width will be allowed, provided the variation is gradual and does not detract from the general appearance. Segments of broken line may vary up to 1 foot {0.3 m} from the required length. Segments shall have neat edges without mist or drip. Variations from the control guide up to 1 inch {25 mm} will be allowed provided the variation does not increase or decrease at a rate of more than 1/2 of an inch {13 mm} in 20 feet {7.5 m}. Lines that do not meet these tolerances shall be removed and replaced, without additional compensation. Establishment of tolerances does not relieve the Contractor of responsibility to construct as closely as practicable to exact plan dimensions.

2. TEMPORARY STRIPE.

The width of the temporary stripe shall not exceed 4 inches {100 mm}, but shall have a 1/2 inch {13 mm} under tolerance. Traffic marking tape shall have a nominal 4 inch {100 mm} width. The tolerance for the lengths of the temporary broken stripe sections shall be 1 foot {0.3 m} under and 1 foot {0.3 m} over the length specified in Subitem 701.03(e)5.a. Strict compliance to alignment on underlying surfaces will not be required provided a reasonable straight line of markings is obtained. The tolerances for placement on a wearing surface shall be the same as those for permanent striping.

3. FAILURE TO MEET WIDTH AND LENGTH PLACEMENT TOLERANCES.

Permanent or temporary striping placed on a final wearing surface that does not meet the tolerances specified shall be removed and replaced without compensation. This includes areas where the permanent striping does not match the alignment, spacing, etc. of the temporary stripe, leaving the temporary stripe exposed.

Portions, or as much as the entire pavement surface, shall be overlaid with a bituminous plant mix layer in extreme cases of disfigurement of the pavement due to stripe removal. The Engineer will make the final determination of the severity of the disfigurement, the requirement for the extent of the overlay, and the material and placement requirements for the plant mix required for the overlay. The Contractor shall place the overlay without compensation.

(l) PROTECTION OF TRAFFIC STRIPE.

Traffic shall be prevented from crossing traffic stripe that is not dried, cured or taken a set to bear the traffic. The Contractor shall use a sufficient number of flagmen or other protection for the stripe to prevent traffic from damaging the newly applied stripe.

Sections of traffic stripe that have been marred or picked up by traffic shall be repaired and the pavement shall be cleaned outside the limits of the stripe. Repair and cleaning shall be done by the Contractor without extra compensation.

(m) PROTECTION OF TRAFFIC.

The Contractor shall furnish and place without extra compensation all warning and directional signs required to direct, control and protect the traveling public while marking and striping operations are in progress. Temporary barricades and signs of the design shown on the plans or directed by the Engineer shall be placed as shown on the plans at the beginning and end of the section that the Contractor proposes to stripe in one operation. As soon as the striping material has dried or cured sufficiently in any one section to permit traffic to cross the traffic line, the temporary barricades and signs shall be moved ahead to the next section. Barricades and signs shall not be left in place overnight.

The striping equipment shall be operated in a manner to cause the least disruption to the normal flow of traffic.

701.04 Method of Measurement.

(a) ITEMS 701-A, 701-B, 701-C, 701-E, 701-F, AND 701-G.

Solid or broken traffic stripe (Items 701-A, and 701-C) will be measured in miles {kilometers} along the centerline of each stripe either by direct measurement and computation to the nearest 0.001 mile {0.001 kilometer} or by odometer to the nearest 0.001 mile {0.001 kilometer}.

Solid, broken, or dotted traffic stripe (Items 701-B, 701-E, 701-F and 701-G) will be measured in linear feet {meters} along the centerline of the stripe to the nearest linear foot {meter}.

The length of broken traffic stripe and dotted traffic stripe complete in place and accepted will include the gaps shown on the plans as a part of the traffic line design but will not include the length of any other gap or section omitted by the Engineer.

Each 4 inch {100 mm} or 6 inch {150 mm} wide traffic stripe will be measured separately for payment.

(b) ITEMS 701-D AND 701-H.

Any traffic stripe, existing or temporary, removed as directed (Items 701-D and 701-H) will be measured in the same manner noted for placement of the type stripe involved.

Removal of markings or legends will be measured and paid for under the appropriate item provided in Section 703.

(c) ITEM 701-K.

Retroreflectometers will be measured per each device including attachments, operator's manuals and transfer of ownership to the Department.

(d) ITEM 701-L.

Micrometers will be measured per each set (one bridge and one cantilever micrometer) including attachments, operator's manuals and transfer of ownership to the Department.

(e) ITEM 701-M

Spectrocolorimeters will be measured per each device including attachments, operator's manuals and transfer of ownership to the Department.

701.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The length of Solid or Broken Traffic Stripe, Item 701-A, and the length of Solid or Broken Traffic Stripe, Item 701-G, measured as noted above, will be paid for at the respective contract unit prices and shall be full compensation for the stripe including the cleaning of the pavement, the furnishing and applying of the striping material, and for all equipment, tools, labor and incidentals necessary to complete the item of work.

The length of Dotted Traffic Stripe, Item 701-B, measured as noted above, will be paid for at the contract unit price which shall be full compensation for furnishing all materials of the appropriate color consistent with the use of the stripe in accordance with the plan details, the preparation of the pavement, the application of the striping material, and for all equipment, tools, labor and incidentals necessary to complete this item of work.

The length of Solid or Broken Temporary Traffic Stripe, Item 701-C, and the length of Solid or Broken Temporary Traffic Stripe, Item 701-E, and Dotted Temporary Traffic Stripe, Item 701-F, measured as noted above, will be paid for at the respective contract unit prices which shall be full compensation for the furnishing of all materials, of the appropriate color consistent with the use of the stripe in accordance with the requirements of the plan details and the MUTCD, the preparation of the surface, the placing of the material, the maintenance of the traffic stripe, and for all equipment, miscellaneous materials, tools, labor and incidentals necessary to complete the item of work.

The length of existing or temporary Solid or Broken Traffic Stripe Removed, Item 701-D, and the length of Solid, Broken, or Dotted Traffic Stripe Removed, Item 701-H, measured as provided above, will be paid for at the contract unit price which shall be payment in full for all materials, equipment, tools, and labor necessary to complete the work. When the traffic stripe to be removed consists of pavement markers used as traffic stripes the cost of removing markers, marker adhesive, and existing paint, plastic or tape located between the markers shall also be included in the price.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

701-A Solid/Broken Color, Class * Type ** Traffic Stripe - per mile {kilometer}
701-B Dotted Class * Type ** Traffic Stripe - per linear foot {meter}
701-C Solid/Broken Temporary Traffic Stripe (***) - per mile {kilometer}
701-D Solid/Broken Traffic Stripe Removed (***) - per mile {kilometer}
701-E Solid/Broken Temporary Traffic Stripe (***) - per linear foot {meter}
701-F Dotted Temporary Traffic Stripe (***) - per linear foot {meter}
701-G Solid/Broken Color, Class * Type ** Traffic Stripe - per linear foot {meter}
701-H Solid/Broken/Dotted Traffic Stripe Removed (***) - per linear foot {meter}

* Specify "1", "1H", "2", "2T", or "3" or "W".
** Specify "A" or "B".
*** Specify "Paint", "Plastic", "Tape", etc., only if required.

SECTION 703
TRAFFIC CONTROL MARKINGS AND LEGENDS

703.01 Description.

This Section shall cover the work of placing permanent or temporary traffic control markings and legends at the locations shown on the plans or where directed by the Engineer. This Section shall also cover the removal of existing or temporary traffic control markings and legends.

703.02 Materials.

Materials shall be furnished in accordance with the requirements given in Sections 856 and 857. The required dimensions, color, type of material and reflectivity will be shown on the plans.

The required type of material will be designated by "Class" and "Type" in accordance with the requirements given Section 701

Class 1H, Class 2, and Class 2T materials shall be in compliance with the formulations given in the tables in Section 856 for each class.

Class 1, Class 3, Class W and Drop On Glass Beads shall be one of the materials shown on List V-3, Temporary Traffic Marking Materials, and List V-4, Permanent Traffic Marking Materials. These lists are in the Department's Manual, "Materials, Sources, and Devices with Special Acceptance Requirements". Information concerning these lists is given in Subarticle 106.01(f) and ALDOT-355.

703.03 Construction Requirements.

(a) ACCEPTANCE PROGRAM FOR TRAFFIC MARKING MATERIALS.

The guidelines for the evaluation and acceptance of traffic marking materials are given in the procedure ALDOT-420 "Acceptance Program for Traffic Marking Materials". These guidelines shall be followed in the furnishing and placement of traffic markings and legends.

(b) TEMPORARY TRAFFIC MARKINGS AND LEGENDS.

Temporary traffic control markings and legends shall be furnished and placed in accordance with all of the requirements given in Section 701 for Temporary Traffic Stripe except for the placement tolerances for length and width. The length of the markings and legends shall be no greater than 2 inches {50 mm} over or 1 inch {25 mm} under the required length. The width of the markings and legends shall be no greater than 1/2 of an inch {12 mm} over or 1/2 of an inch {12 mm} under the required width.

(c) PERMANENT TRAFFIC MARKINGS AND LEGENDS.

Permanent traffic control markings and legends shall be furnished and placed in accordance with all of the requirements given in Section 701 for permanent traffic stripe except for the following:

- any type of equipment may be used that produces acceptable results;
- Class 2 thermoplastic shall be placed to produce a minimum uniform thickness of 0.125 inches {3.0 mm}.

- the length of the markings and legends shall be no greater than 2 inches {50 mm} over or 1 inch {25 mm} under the required length.

- the width of the markings and legends shall be no greater than 1/2 of an inch {12 mm} over or 1/2 of an inch {12 mm} under the required width.

(d) REMOVING MARKINGS OR LEGENDS.

The removal of traffic markings and legends shall be done in accordance with the requirements given in Section 701.

703.04 Method of Measurement.

The area of Traffic Control Markings or Legends (Items 703-A, 703-B, 703-F, and 703-G) complete in place and accepted will be the sum of the areas shown on the plans for each marking and legend constructed within the required placement tolerance.

The Removal of Traffic Control Markings or Legends (Item 703-C) shall be measured in the same manner as prescribed above except that it shall cover only the area from which the markings were actually removed.

The area of Temporary Traffic Control Markings or Legends, (Items 703-D and 703-E) complete in place and accepted, will be the sum of the areas shown on the plans for each marking and legend constructed within the required placement tolerance. No measurement for payment will be made for the removal of temporary markings or legends, the removal of such being classified as incidental to the Items of Temporary Traffic Control Markings and Temporary Traffic Control Legends.

703.05 Basis of Payment.

(a) UNIT PRICE COVERAGE.

The accepted square feet {square meters} of Traffic Control Markings or Legends, Items 703-A, 703-B, 703-F, and 703-G, measured as provided above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes the cleaning of the pavement, furnishing and applying the markings or legends, and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

The accepted square feet {square meters} of Traffic Control Markings or Legends Removed, Item 703-C, measured as provided above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes traffic control for removal, all necessary materials, equipment, tools, labor and incidentals necessary to complete the work.

The accepted square feet {square meters} of Temporary Traffic Control Markings or Legends, Items 703-D and 703-E, measured as noted above, will be paid for at the contract unit price bid which shall be full compensation for the item complete in place and includes the cleaning of the pavement, furnishing and applying the markings or legends, traffic control for placing, and for all materials, equipment, tools, labor and incidentals necessary to complete the work.

(b) PAYMENT WILL BE MADE UNDER ITEM NO.:

703-A Traffic Control Markings, Class ____ , Type ____ - per square foot {square meter}
703-B Traffic Control Legends, Class ____ , Type ____ - per square foot {square meter}
703-C Removal of Traffic Control Markings or Legends- per square foot {square meter}
703-D Temporary Traffic Control Markings - per square foot {square meter}
703-E Temporary Traffic Control Legends - per square foot {square meter}
703-F Cold Laid Polymeric Traffic Control Markings - per square foot {square meter}
703-G Cold Laid Polymeric Traffic Control Legends - per square foot {square meter}

SECTION 856
TRAFFIC MARKING MATERIALS

856.01 Acceptance Program for Traffic Marking Materials.

The guidelines for the evaluation and acceptance of traffic marking materials are given in the procedure ALDOT-420 "Acceptance Program for Traffic Marking Materials". These guidelines shall be followed in furnishing traffic marking materials.

856.02 Packaging and Labeling of Containers.

Traffic marking materials shall be shipped in containers that are plainly marked with the weight in pounds per gallon {kilograms per liter}, the volume in gallons {liters}, the color, user information, date of manufacture, lot and batch number. Each batch shall have a unique number. A statement of the percentage composition of the pigment, the proportion of pigment to vehicle, and the name and address of the manufacturer shall also be shown. The label shall contain any instructions for special handling or precautions for use of the material that are recommended by the manufacturer. Containers with inadequate indentification and marking will not be accepted for use.

The date of manufacture and the shelf life shall be shown for materials that have a shelf life.

Preformed thermoplastic materials and permanent tape products shall be marked with content, color, date of manufacture and lot number.

856.03 Color and Luminance Factor

The installed materials for pavement stripe, markings and legends shall meet the performance requirements given in ASTM D 6628 with the exception of the following:

The initial daytime chromaticity for yellow materials shall fall within the box created by the following coordinates:

Initial Daytime Chromaticity Coordinates (Corner Points)				
	1	2	3	4
X	0.530	0.510	0.455	0.472
Y	0.456	0.485	0.444	0.400

The initial daytime chromaticity for white materials shall fall within the box created by the following coordinates:

Initial Daytime Chromaticity Coordinates (Corner Points)				
	1	2	3	4
X	0.355	0.305	0.285	0.335
Y	0.355	0.305	0.325	0.375

White and yellow materials shall meet the following luminance factor requirements:

- White: Daylight luminance factor at 45 degrees/0 degrees - 50 % minimum;
- Yellow: Daylight luminance factor at 45 degrees/0 degrees - 35 % minimum.

856.04 Environmental Requirements.

All yellow materials using lead chromate pigments shall meet the criteria of non-hazardous waste as defined by 40 CFR 261.24 when tested in accordance with EPA Method 1311, Toxicity Characteristics Leaching Procedures (TCLP). The striping and marking material, upon preparation and installation, shall not exude fumes which are toxic, or detrimental to persons or property. All material using lead free pigments shall NOT contain either lead or other Resource Conservation and Recovery Act (RCRA) materials, in excess of the standard defined by EPA Method 3050 and 6010.

856.05 Glass Beads.

Glass Beads shall meet the requirements given in AASHTO M 247 and the USDOT "Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects", 2003 Edition,

Section 718.19 "Glass Beads". Type 1, 3 and 4 glass beads used for drop on beads shall be coated with a bead coating that is compatible with the traffic marking material to which the glass beads will be applied and will provide adequate moisture proofing, increased adhesion, and optimum embedment of the glass beads. Beads used in the intermix (premixed with paint, thermoplastic or other striping materials) are not required to be coated.

Glass beads shall meet the gradations shown in the following table.

GRADATIONS OF GLASS BEADS, % PASSING DESIGNATED SIEVE				
Sieve Size *	Type of Gradation			
	Type 1	Type 3	Type 4	50/50 Intermixed
10			100	
12		100	95 - 100	100
14		95 - 100	80 - 95	95 - 100
16	100	80 - 95	10 - 40	85 - 100
18		10 - 40	0 - 5	55 - 75
20	95 - 100	0 - 5	0 - 2	40 - 60
25		0 - 2		40 - 60
30	75 - 95			35 - 55
40				
50	15 - 35			5 - 25
80				
100	0 - 5			0 - 5
* Sieve analysis in accordance with the requirements given in ASTM D 1214				

856.06 Class 1 Paint.

Class 1 paint shall be one of the materials shown on List V-4, Permanent Traffic Marking Materials. List V-4 is in the Department's Manual, "Materials, Sources and Devices with Special Acceptance Requirements". Manufacturers of Class 1 paint shall participate in ALDOT-420, "Acceptance Program for Traffic Marking Materials".

856.07 Class 1H High Build Paint.

Class 1H paint shall not be used after the expiration of the shelf life. The paint shall be easily stirred and mixed to a uniform consistency prior to use.

Manufacturers of Class 1H paint shall participate in ALDOT-420, "Acceptance Program for Traffic Marking Materials".

Class 1H High Build Paint shall meet the following requirements.

PHYSICAL AND PERFORMANCE REQUIREMENTS FOR HIGH BUILD TRAFFIC PAINT		
PROPERTY	VALUE	TEST METHOD
Acrylic Resin	100 % Rohm & Haas Rhoplex Fastrack HD-21A emulsion with 48.5 - 49.5 % solids content, or Dow DT 400NA acrylic emulsion with 49.5 - 51.5 % solids content, or an approved equal.	ASTM D 2743 Infrared Spectral Analysis
Nonvolatiles in Vehicle	42 % Minimum by Weight	ASTM D 215
No Track Time	Maximum of 10 minutes	ASTM D 711
Volatile Organic Content	Maximum of 1.25 Pounds per Gallon	ASTM D 3960
Pigment Content	Minimum of 55% by Weight Maximum of 62% by Weight	ASTM D 3723
Total Solids Content	Minimum of 73 % by Weight Maximum of 79 % by Weight	ASTM D 2369
White Pigment Content, Rutile Titanium Dioxide	Minimum of 1.0 Pound per Gallon	ASTM D 476
Yellow Pigment Content, Hansa Yellow (11-2400)	% minimum per manufacturer	-
Viscosity @ 77°F (25°C) Kreb Units	78 - 95	ASTM D 562
Density in Pounds per Gallon	White - 13.7 Minimum Yellow - 13.1 Minimum	ASTM D 1475
Scrub Resistance	Pass Minimum 300 cycles	ASTM D-2486
PH	9.6 Minimum	ASTM E 70
Daylight Reflectance %	White - 80 Minimum Yellow - 50 Minimum	ASTM E 1349

856.08 Class 2, Standard Thermoplastic.

Thermoplastic shall be alkyd based materials. Manufacturers of Class 2 Thermoplastic shall participate in ALDOT-420, "Acceptance Program for Traffic Marking Materials".

Reflective glass beads shall be mixed into the thermoplastic as a part of the manufacturing process. The intermixed glass beads shall be 50 % Type 1 and 50 % Type 3 beads. The pigment, glass beads and filler shall be well dispersed in the resin. The composition of Class 2 thermoplastic material shall be in accordance with the following.

COMPOSITION OF CLASS 2 STANDARD THERMOPLASTIC (% BY WEIGHT)				
COMPOSITION	VALUE FOR WHITE	VALUE FOR YELLOW (Lead Free)	VALUE FOR YELLOW (Leaded)	TEST METHOD
Binder	20.0 % minimum	20.0 % minimum	20.0 % minimum	AASHTO T 250
White Pigment TiO2, Type II Rutile	10.0 % minimum	-	1.5 % minimum	ASTM D 476
Glass Beads (Intermixed)	40.0 % minimum	40.0 % minimum	40.0 % minimum	AASHTO T 250
Yellow Pigment, Lead Chromate	-	N/A	5.0 % minimum *	AASHTO T 250
Yellow Pigment, Organic Pigment Yellow 83	-	% minimum per manufacturer **	N/A	-
Calcium Carbonate and Inert Filler (-200 mesh {-75 µm} sieve)	30.0 % maximum	37.5 % maximum	33.5 % maximum	ASTM D 1199
* Note: For yellow leaded thermoplastic markings the pigment shall be silica encapsulated lead chromate yellow, containing a minimum of 42 % lead. ** Note: For yellow lead free markings the pigment shall be an organic pigment yellow 83. The lead free yellow thermoplastic material shall contain no more than 100 ppm of lead, cadmium, or hexavalent chromium.				

The physical requirements for the thermoplastic shall be in accordance with the following.

PHYSICAL REQUIREMENTS OF CLASS 2 STANDARD THERMOPLASTIC (% BY WEIGHT)			
PROPERTY	MAXIMUM	MINIMUM	TEST METHOD
Water Absorption	0.5 %	-	ASTM D 570
Softening Point	-	195 °F {90 °C}	ASTM D 36
Low Temperature Stress Resistance	-	Pass	AASHTO T 250
Specific Gravity	2.3	1.9	ASTM D 792
Indentation Resistance	75	40	ASTM D 2240* Shore Durometer, A2
Impact Resistance	-	1.0 N·m	ASTM D 256, Method A
Flash Point	-	475 °F {245 °C}	ASTM D 92
*The durometer and panel shall be at 110 °F {45°C} with a 4.4 lb {2.0 kg} load applied. Instrument measurement shall be taken after 15 seconds.			

856.09 Class 2T, Thin Film Spray Applied Thermoplastic.

Thermoplastic shall be alkyd based materials. Manufacturers of Class 2T Thermoplastic shall participate in ALDOT-420, "Acceptance Program for Traffic Marking Materials".

Reflective glass beads shall be mixed into the thermoplastic as a part of the manufacturing process. The intermixed glass beads shall be shall be Type 1 beads. The pigment, glass beads and filler shall be well dispersed in the resin.

The composition of Class 2T thermoplastic material shall be in accordance with the following.

COMPOSITION OF CLASS 2T THERMOPLASTIC (% BY WEIGHT)				
COMPOSITION	VALUE FOR WHITE	VALUE FOR YELLOW (Lead Free)	VALUE FOR YELLOW (Leaded)	TEST METHOD
Binder	25.0 % minimum	25.0 % minimum	25.0 % minimum	AASHTO T 250
TiO2, Type II Rutile	10.0 % minimum	-	1.5 % minimum	ASTM D 476
Glass Beads (Intermixed)	35.0 % minimum	35.0 % minimum	35.0 % minimum	AASHTO T 250
Yellow Pigment: Lead Chromate	-	N/A	5.0 % minimum *	AASHTO T 250
Yellow Pigment: Organic Pigment Yellow 83	-	% minimum per manufacturer **	N/A	-
Calcium Carbonate and Inert Filler (-200 mesh {-75 µm} sieve)	30.0 % maximum	40.0 % maximum	33.5 % maximum	ASTM D 1199
*Note: For yellow leaded thermoplastic markings the pigment shall be silica encapsulated lead chromate yellow, containing a minimum of 42 % lead. **Note: For yellow lead free markings the pigment shall be an organic pigment yellow 83. The lead free yellow thermoplastic material shall contain no more than 100 ppm of lead, cadmium, or hexavalent chromium.				

The physical requirements for the thermoplastic shall be in accordance with the following.

PHYSICAL REQUIREMENTS OF CLASS 2T THERMOPLASTIC (% BY WEIGHT)			
PROPERTY	MAXIMUM	MINIMUM	TEST METHOD
Water Absorption	0.5 %	-	ASTM D 570
Softening Point	-	190°F {90 °C}	ASTM D 36
Low Temperature Stress Resistance	-	Pass	AASHTO T 250
Specific Gravity	1.87	-	ASTM D 792
Indentation Resistance	30	5	ASTM D 2240* Shore Durometer, A2
Impact Resistance	-	1.0 N·m	ASTM D 256, Method A
Flash Point	-	475 °F {245 °C}	ASTM D 92
*The durometer and panel shall be at 110 °F {45°C} with a 4.4 lb {2.0 kg} load applied. Instrument measurement shall be taken after 15 seconds.			